LOCKING DEVICE FOR BUILT PIPE CONNECTIONS

The present invention concerns a mechanical locking device for built pipe connections used on drilling rigs.

Technical Background

When drilling, a top drive or tower drill is used as drive unit for rotation and handling of the drill string when this is vertical in the centre of the well. The tower drill was introduced on the market around 1980 to replace the Kelly and rotary table, which up to that point had been the only available drive system. The main object of the tower drill is that the momentum of rotation is provided to the drill string at the top, instead of through a rotation pipe. The system can rotate and pump drilling mud continuously during drilling due to application of hydraulic or electric motors arranged above the pipe. The tower drill is frequently used on land-based rigs. The tower drill is connected to the top of the drill string directly via standard threads used in this industry.

These connections comprise a male and a corresponding female threaded section. Both API and NC threads are used. Further specifications are available in the API standards.

Some machines utilize a torque wrench to tighten and loosen the connection between the drilling machine and drill string. For example in the following connections:

- Between machinery and intermediate sub (between the tower drill and the intermediate sub/cross-over sub)
- Between the intermediate sub and an internal blow out preventer (IBOP),
- Between machinery and IBOP

- Between IBOPs if more than one are installed, and
- Between IBOP and saver sub.

As alternative to the torque wrench, the drilling machinery can be provided with a back-up grabber. In such an arrangement, the drive unit of the machinery is used as power source to provide the required torque when tightening or loosening the connections described above.

For drilling machinery provided with a back-up grabber or back-up tong, it is of importance that the connection between machinery and the elements described above remains intact when the machinery is released from the drill string. The interlocking between the parts is normally provided by a set of flanges with an internal conical slot and fitted split inner rings. When the flanges are connected by a number of bolts, the inner ring is forced towards the connection units and a locking by friction is provided. This causes a secure locking, but the installation and dismantling is time-consuming and the risk of injury is high.

Brief description of the invention

It is an object for the present invention to provide a mechanical locking device for threaded pipe connections in drilling rigs which offers a secure locking without the use of flange connections.

A further object of the invention is to provide a locking device which can be applied irrespective of the radial orientation of the connected pipes.

A further object of the invention is to provide a locking device which can be operated more safely and faster than the flange arrangements that are currently in use.

Brief Description of the Figures

The invention will be described in detail in a preferred embodiment with reference to the appended figures, where:

Figure 1 is an exploded view of the locking device according to the invention,

Figure 2 is a perspective view of the locking device according to the invention,

Figure 3 is a perspective view of a first locking ring,

Figure 4 is a side view of a first locking ring,

Figure 5 is an axial side view of the ring in figures 3 and 4.

Figure 6 is an axial side view of the ring in figures 3 and 4.

Figure 7 is a side view of the ring in figure 3 and 4 with sections A-A and B-B

Figure 8 is a perspective view of a second locking ring,

Figure 9 is a side view of a second locking ring,

Figure 10 is an axial side view of the ring in figures 8 and 9.

Figure 11 is an axial side view of the ring in figures 8 and 9.

Figure 12 is a side view of the ring in figure 8 and 9 with sections A-A and B-B.

Detailed description of the invention

The invention comprises a device for locking threaded pipe connections for use on drill rigs. The locking arrangement comprises a first and a second ring 1, 2 with axial teeth 3, 4, 5, 6 and connection units 7, 8 with a number of notches and teeth 9, 10, 11, 12. The locking device is intended to secure the connection further, in addition to the momentum of torque applied according to present specifications, before the rings 1, 2 are positioned and locked.

Due to the number of teeth 3, 4, 5, 6 and the distribution of the teeth, the locking can be applied independent of the radial position of the connection units 7, 8 with respect to each other after the threaded connection is completed. This is possible due to a different number of teeth 3, 6 on the first and second locking ring 1, 2 and their mutual positioning. The first 1 and second 2 ring have an even and odd number of teeth 3, 6, respectively, and a corresponding number of notches 11, 12 in the drilling machine/drill string connection or other connection 7, 8. In this embodiment there are 17 and 18 teeth 3, 6 on the second and first ring, respectively. The teeth 3, 6 are evenly distributed around the periphery of the rings as shown in Figures 2 and 4. However, the number of teeth 3, 6 may vary, as may their dimensions and distribution around the periphery. However, changing these parameters will cause a variation of the system's tolerance for radial dyslocation of the two connection units. The preferred ratios of dimension are shown in the appended figures.

The two locking rings 1, 2 in each connection engage each other via a plurality of axially oriented teeth 4, 5 on the first edge of the first 1 and second 2 locking ring, respectively. In this example there are four teeth 4, 5 on each ring 1, 2. When connecting the threaded sections, the two locking rings 1, 2 abut each other as tightly as

possible with the four teeth 4, 5 in engagement in corresponding slots. When the threaded sections are connected, the two locking rings 1, 2 are spread apart and revolved on a shoulder 15, 16 on the connection units to bring the teeth 3, 6 at the first 1 and second 2 rings other edge in engagement with the notches 11, 12 on the two connection units 7, 8. The rings can be spread apart manually, mechanically or by other means and then be locked by means of locking means 13, such as e.g. bolts arranged in cavities 14 in one of the locking rings 1, 2. The final position of the rings 1, 2 will depend on the radial orientation of the connection units with respect to each other. Due to the different number of teeth 3, 6 and their orientation there will always be a position where the two locking rings 1, 2 engage the notches 11, 12 in the two connection units 7, 8 simultaneously. Hence, the locking rings 1, 2 will engage each other, and each of the rings 1, 2 will engage the first and second connection unit 7, 8, respectively. The locking rings therefore provide a radial interlocking of the two connection units 7, 8 with respect to each other, so that they can not be screwed apart.

The two locking rings 1, 2 according to the embodiment shown in the drawings are designed as follows. The first ring 1 is provided with four teeth 4 and notches for engagement in the equally shaped teeth 5 and notches in the second ring 2. In the example the teeth 4, 5 form a 45° sector of the edge of the ring. The height of the teeth is 73 mm. The notches correspond to the teeth 4, 5 with the necessary clearance. The teeth 3, 6 on the opposite sides of the two rings 1, 2, that is on the side which will engage the connection units 7, 8, are not formed identically on the first 1 and second 2 locking ring.

The first locking ring 1 is provided with an odd number of teeth 3 on the side facing the connection unit 7. In the example in figure 3 the number of teeth 3 is seventeen, hence, the number of notches is seventeen. One half of a

tooth 3 and one half of a notch together form a 10,59° sector of the ring's edge. Each tooth 3 has a height of 10 mm, and each notch corresponds to the teeth 3 on the connection unit with the necessary clearance.

The second locking ring 2 is provided with an even number of teeth 6 on the side facing the connection unit 8. In the example in figure 2 the number of teeth is eighteen, hence the number of notches is also eighteen. One half of a tooth 6 and one half of a notch together form a 10° sector of the ring's edge. Each tooth 6 has a height of 10 mm, and each notch corresponds to the teeth 6 on the connection unit 8 with the necessary clearance.

All dimensions can be varied and must be adapted to the size of the connection units 7, 8 and to the forces acting on the locking device. Hence, all dimensions are examples only, and the invention is solely limited by the appended patent claims.